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Vocational and Technical Education in Peru

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and
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Peruvian vocational and technical students often end up working in the same jobs for the same earnings as academic students — probably because teaching in both streams is largely "chalk and talk" and vocational and technical education students get little "hands-on" technical experience in school.

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The costs of the academic and the vocational and technical education (VTE) streams in Peru are very close. What's more, the monetary returns to, and occupational profiles of, graduates of the two streams are almost identical — with one exception.

For the self-employed who live in urban areas outside Lima, the returns to secondary technical education are significantly lower than the returns to secondary general education. This may be because the quality of VTE programs for urban students outside Lima is generally lower than the quality of education for academic students in the same areas.

Why, for other groups, do the two educational streams produce almost identical returns and graduates with similar occupational profiles? VTE institutions, funded at the same level as academic institutions, can't afford the inputs that make VTE genuinely technical, so the students get little "hands-on" technical experience in school. Despite declared differences in emphases and goals, programs and curricula in the two streams are substantially alike — largely "chalk and talk."

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VOCATIONAL AND TECHNICAL EDUCATION IN PERU

Peter R. Moock and Rosemary T. Bellew[1]

1. Introduction

The purpose of this study is to assess the economic returns to vocational and technical education (VTE) in Peru. Studies in other developing countries have concluded that VTE is more costly to provide than "general" (i.e., academic) education, yet it yields returns that are not significantly different. This has led to the policy recommendation that countries should promote general education at the expense of VTE. For the creation of occupation- and job-specific skills, countries should, according to this view, rely not on school-based instruction, but rather on training to be given to individuals after they have left school and entered the labor market. Such training can be provided either on the job or in industry-based training centers including proprietary institutions.

The relative costs of and returns to VTE and general education are investigated here for Peru. The paper proceeds as follows. Section 2 describes the system of education in Peru and changes that have occurred in this system over time. Section 3 surveys the (relatively sparse) literature on comparative rates of return to VTE and general education. Sections 4 and 5 describe, respectively, the data used for this study and the model used to estimate the returns to different levels and types of education. Section 6 reports the results of the empirical analysis. Section 7 introduces data obtained from Peru's Ministry of Education on the relative costs of VTE and general education. The concluding section 8 considers the implications, if any, of the findings for educational policy.

2. VTE in Peru

The recent history of education in Peru, as it relates to the provision of VTE, can be divided into three distinct phases. Prior to 1972, and again after 1982, official policy split the system of education into two separate sub-systems, or educational "streams." The focus of the general stream was on the development of broad cognitive skills assumed to be useful in a wide variety of occupations and necessary also for students who wanted to continue their studies at higher levels of the education system. The VTE stream, in addition to teaching these basic skills, was intended to orient students generally to the world of work and provide them with training specific to a future occupation of their choice. Between 1972 and 1982, there was an attempt to merge the two scholastic streams and, for most students up through secondary education, to increase the vocational content of the curriculum. This attempt to "vocationalize" or "diversify" primary and secondary education is one with many historical

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parallels in other parts of the world (Psacharopoulos and Loxley 1985, pp. 11-16).

The distinction on paper between VTE and general education during the first period, in what can be referred to as the "traditional" system of Peruvian education, is illustrated in figure 1. Students who chose the VTE option under this system could cross over from the general stream at either of two points -- after completing primary education (into a secondary technical school) or after completing general secondary education (into a post-secondary polytechnic or vocational institute).

Secondary education consisted of two sequential cycles. All students followed the same curriculum in the three-year lower cycle of the general stream; in the two-year upper cycle, they could choose between letras (humanities) or ciencias (sciences). In the lower cycle of the VTE stream, students took many academic subjects, plus a smaller number of technical subjects designed to orient them generally to the world of work. In the upper cycle, students entered separate agricultural, business, or applied science institutes where they began their specialization,[2] but even here, the curriculum often stressed quite general skills with broad occupational applications.

Post-secondary VTE institutes were known as Institutos de Educacion Tecnica Superior (IETSs). The IETSs provided training in professional areas such as agriculture, business administration, public relations, interior decorating, and cosmetology. Study at an IETS provided a popular alternative for students unable to obtain admission to a university.

Many new secondary technical schools and higher-level technical institutes were established during the 1950s and 1960s to help satisfy the growing demand for education. Between 1955 and the late 1960s, enrollments in the VTE stream increased approximately fourfold (Romero 1963; Paulston 1971). This expansion matched the rapid increase of education in general. VTE institutions accounted for approximately 18 percent of all secondary and tertiary enrollments over most of this period (World Bank 1988).

Despite their expansion, however, there were reasons to doubt the capacity of VTE institutions to satisfy the specific vocational objectives set out for them. Because planning and guidance were inadequate, some students were trained in areas for which there was little or no demand. For many others, the education given them did not prepare them well for the jobs that were available. "Blackboard teaching" was the dominant mode of instruction. Most schools and institutes operated with inadequate materials and equipment, with the result that students spent little or no

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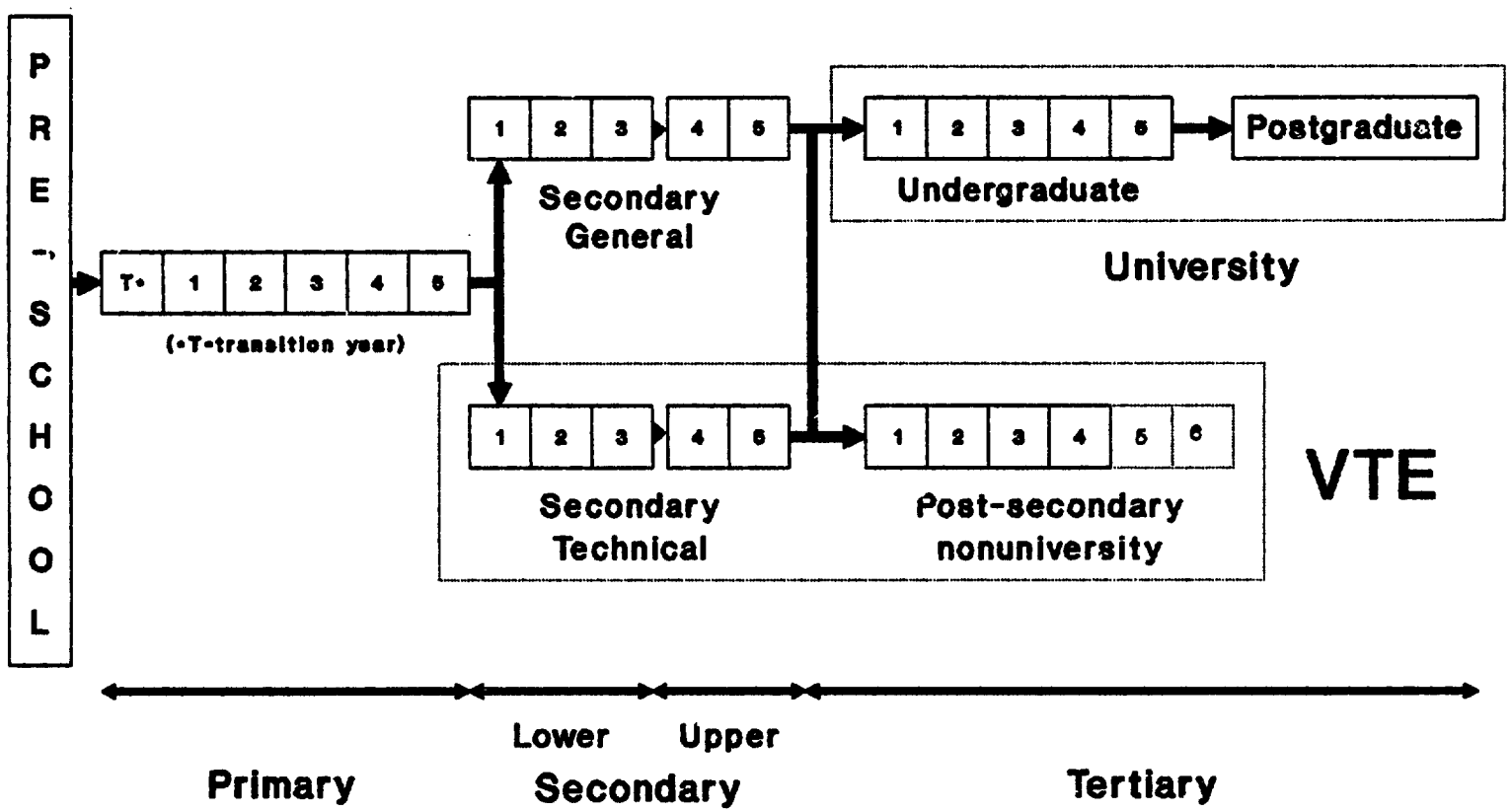
[2] Students could select either a general course of study in such areas as agriculture and business or trade-specific courses in bookkeeping, shorthand, typing, or animal husbandry. Alternatively, boys could specialize in carpentry, metalworking, or automotive mechanics, and girls could choose weaving, dressmaking, embroidery, or decorative arts.

Figure 1

THE STRUCTURE OF EDUCATION IN PERU



time doing practical work. About 80 percent of the teachers in VTE institutions were "underqualified" to teach technical subjects (Paulston 1971, World Bank 1973). Moreover, many students never intended to be technicians when they enrolled in VTE programs in the first place but, instead, did so in the (usually futile) hope of continuing their study later at a university.

Given the deficiencies in facilities and personnel and the prevailing preferences of those enrolled, many VTE institutions had little real choice but to offer programs that resembled those given in the general educational streams, with weight given to the liberal arts and relatively little to those technical subjects linked to specific occupational outcomes. Only a small proportion of VTE graduates obtained employment in areas directly related to their areas of VTE concentration.

In response to the perceived problems surrounding VTE, Peru's military government announced a program of educational reform in 1972. The reform was designed to enhance student employment prospects by raising the quality of instruction and increasing education's relevance to the labor market.[3] The crux of the program was its "diversified" curriculum, i.e., a merging of the academic and technical streams.

More specifically, the reform mandated nine years of "basic" education, which was supposed to replace the primary and lower secondary cycles of the traditional system. Toward the end of this basic education, all pupils were to be introduced to practical work, after which all continuing students would attend new three-year schools known as Escuelas Superiores de Educacion Profesional (ESEPs). The curriculum of the ESEPs was to be highly practical, with some academic courses included but far fewer than in the traditional system of general education. Only after secondary education would students under the new system be split into separate streams. Some of the continuing students would go to university, and the rest would enter Second-Cycle (Ciclo II) ESEPs.[4]

The reform program was implemented slowly, and it was relatively short-lived. Nonetheless, it did have an impact on Peruvian education. First-Cycle ESEPs increased in number, from just nine schools and about 9,000 students in 1975 to 72 schools and 30,000 students in 1981 (Gray 1983; World Bank 1982). At the post-secondary level, three Second-Cycle

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[3] Earlier, in 1961, private employers in the manufacturing sector had organized their own non-formal system to provide training for those leaving the formal education system. This system, known as the Servicio Nacional de Aprendizaje y Trabajo Industrial (SENATI), continues to this day. SENATI centers offer training programs in a variety of technical areas. During the first decade of its operation, over 100,000 industrial workers participated in SENATI courses (World Bank 1973).

[4] Not part of the original reform of 1972, the Second-Cycle ESEPs were introduced in the late 1970s by the succeeding military administration. They were designed to replace the old IETSs.

ESEPs were constructed, and approximately 20 of the older IETSs were converted to Second-Cycle ESEPs. There was, however, considerable uncertainty about the value of ESEP courses to universities and employers. As a consequence, many ESEPs were under-enrolled, and most students continued to attend traditional secondary schools and tertiary institutes (World Bank 1982).

In 1982, soon after Peru's return to civilian rule, President Belaunde Terry announced a "new" reform which, with only minor differences, amounted to a return to the traditional system of education. The program to expand the number of First-Cycle ESEPs was halted; students already enrolled were permitted to complete their studies, but no new entrants were accepted. Second-Cycle ESEPs were placed under review, and their future remains uncertain.

3. Previous Studies

Skill formation through vocational and technical education has been an important part of Peru's human capital investment strategy. In this regard, the situation in Peru does not differ from what is found in many other parts of the world. Table 1 shows the proportion of central government recurrent secondary education expenditures allocated to VTE in Peru and, at an aggregate level, in several of the world's principal regions. Peru's proportionate allocation to VTE appears somewhat above average for developing countries, and below that found in the industrialized European countries.

VTE programs are intended to enhance worker productivity and increase earnings by reducing skill shortages and promoting positive attitudes towards work, especially manual work. There is, however, a growing research literature suggesting that VTE programs, as presently constituted in many developing countries, fail to offer returns commensurate with their costs (Blaug 1973; Fong 1976; Psacharapoulos 1986; Metcalf 1985). A number of studies have found returns to VTE and to general education that are comparable, but higher costs in the case of VTE. To the extent that these findings are corroborated in the same countries and elsewhere, VTE is shown to be an inferior investment alternative.

Although the available evidence on the relative costs of VTE and general education nearly always shows VTE to be the more expensive option, the size of the cost differential varies considerably across studies. In Colombia and Tanzania, secondary VTE has been shown to cost 15 to 20 percent more then secondary general education (Psacharopoulos and Loxley 1984), in Venezuela twice as much (Psacharopoulos and Steier 1987), and in Jordan ten times as much (Bukhari 1968). Such differences in the relative costs of VTE from country to country are an indication of the enormous range in curricular content of programs that are all labeled "technical and vocational."

Table 1

EXPENDITURE ON VOCATIONAL AND TECHNICAL EDUCATION AS PERCENT OF CENTRAL GOVERNMENT RECURRENT EXPENDITURE ON ALL SECONDARY EDUCATION, CIRCA 1980

Country/region	Percent
Peru	27
Latin America and the Caribbean (22)	25
Africa (22)	18
Asia (18)	16
Europe (13)	34

Note: In parentheses, the number of countries in each regional sample.

Source: Unesco (1986).

Because the evidence on returns is mixed, conclusions with regard to rates of return are also mixed. Of the studies that report both costs and returns and then calculate a rate of return, a higher rate for investment in secondary VTE is reported for Brazil (20 percent vs 16 percent, Psacharopoulos 1987) and for Venzuela (26 percent vs 20 percent, Psacharopoulos and Steier 1987). Comparable rates to secondary VTE and general education are reported for Colombia (Psacharopoulos 1984) and for Cyprus and Taiwan (Psacharopoulos 1985).

Past studies comparing VTE and general education have focused on secondary education almost exclusively. This study of Peru will be one of the first to extend the comparison to tertiary education.

4. The Peruvian VTE Data Set

To assess the relative returns to VTE and general education in Peru, we make use of the Peruvian Living Standards Survey (PLSS) national probability sample of households and individuals surveyed in 1985/1986.[5] From the full PLSS sample we drew a subsample (n = 2,210) of all urban males between the ages of 15 and 69 who were either employed in the private wage sector or were "self-employed," that is, working for pay in a family enterprise. Rural workers were excluded from the present study because of the small number of such individuals with VTE.[6]

The breakdown of the sample between those who are self-employed and those who are wage-employed, and between those living in Metropolitan Lima and those living in all other urban areas (OUAs) is presented in table 2. The distribution across the four cells is nearly equal, the largest group being the wage-employed in Lima (756), and the smallest the self-employed in Lima (427).

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[5] The PLSS was implemented between June 1985 and July 1986 by Peru's Instituto Nacional de Estadistica (INE). The survey questionnaire was developed by the World Bank in collaboration with INE and the Central Bank of Peru and adapted from a prototype questionnaire used earlier in Cote d'Ivoire. A parallel study to this one comparing the returns to VTE and general education in Cote d'Ivoire is available (Grootaert 1988). For details about the PLSS survey and sample, see Grootaert and Arriagada (1986).

[6] Analyses of the earnings of similar categories of Peruvian workers, without the focus on VTE, are described elsewhere -- see Stelcner, Arriagada, and Moock (1987), which look at the returns to education in general, and Arriagada (1988), which focuses on the returns to training. These two studies are confined also to males, but they they use an upper age cut-off of 65 rather than 69 and they include workers in rural as well as urban areas and in public as well as private employment. Female workers, for whom the specification of an appropriate earnings function will tend to differ, are treated in King (forthcoming) and Arriagada (forthcoming).

Table 2

DISTRIBUTION OF SAMPLE BY LOCATION AND SECTOR

	Metropolitan Lima		Other urban areas		Sector totals	
	Number	Column %	Number	Column %	Number	Column %
Wage employees						
Number	756	63.9	527	51.3	1,283	58.1
Row %	58.9	(34.2)	41.1	(23.9)	100.0	(58.1)
Self-employed						
Number	427	36.1	500	48.7	927	41.9
Row %	46.1	(19.3)	53.9	(22.6)	100.0	(41.9)
Location totals						
Number	1,183	100.0	1,027	100.0	2,210	100.0
Row %	53.5	(53.5)	46.5	(46.5)	100.0	(100.0)

Note: Percentages of the grand total (2,210) are in parentheses.

Table 3 shows that, compared to those in wage employment, the self-employed are on average six years older, they have completed about one year less of school, and they earn about the same amount per hour but work eight hours more per week. Workers in OUAs are about one year older and have completed a year and a half less schooling; they earn 1.25 Intis less per hour and work three hours more per week than workers in Lima.

Table 3

AGE, SCHOOLING, EARNINGS, AND HOURS WORKED BY LOCATION AND SECTOR

	Age in years	Years of school completed	Hourly earnings in June 1985 Intis	Hours worked per week
Metropolitan Lima				
Wage employees	33.6 (12.3)	9.2 (3.4)	6.71 (7.8)	48.43 (14.8)
Self-employed	39.8 (13.3)	8.4 (3.9)	6.37 (6.5)	50.70 (21.4)
All Lima workers	35.9 (13.0)	8.9 (3.6)	6.59 (7.4)	49.25 (17.5)
Other urban areas				
Wage employees	33.7 (12.6)	7.5 (3.5)	4.95 (5.4)	49.51 (16.4)
Self-employed	40.1 (13.3)	7.2 (3.8)	5.75 (7.3)	50.58 (20.4)
All OUA workers	36.8 (13.3)	7.4 (3.7)	5.34 (6.4)	49.98 (18.5)
All urban areas of Peru				
Wage employees	33.6 (12.4)	8.5 (3.6)	5.98 (7.0)	48.87 (15.5)
Self-employed	40.0 (13.3)	7.8 (3.9)	6.04 (7.0)	50.58 (20.8)
All urban workers	36.3 (13.2)	8.2 (3.7)	6.01 (7.0)	49.59 (17.9)

Note: Means (standard deviations in parentheses).

Table 4 shows the number and percentage of workers in each of the samples who finished their education at any particular level and type of school. Only 1.5 percent of urban male workers (13 and 21 individuals, respectively, in the Lima and OUA samples) never went to school at all. About two-thirds (1,477 individuals) and nearly one-fifth (413 individuals) continued their education past the primary and secondary levels.

respectively. Of the 1,477 individuals who continued past primary school, 233 (16 percent) entered the VTE stream, 129 immediately after primary school (into a secondary technical school or First-Cycle ESEP) and 104 after secondary school (into an IETS or Second-Cycle ESEP). Of those whose highest schooling level was secondary, 12 percent did VTE; of those who went on to tertiary education, 25 percent took VTE.

Table 4

HIGHEST EDUCATION LEVEL ATTENDED BY LOCATION AND SECTOR

	None	Primary	Secondary technical	Secondary general	Post-sec. nonuniv.	University	Total
Metropolitan Lima							
Wage employees	8 (1.1)	139 (18.4)	38 (5.0)	392 (51.9)	36 (4.8)	143 (18.9)	756 (100.0)
Self-employed	5 (1.2)	138 (32.3)	26 (6.0)	163 (38.2)	22 (5.2)	73 (17.1)	427 (100.0)
All Lima workers	13 (1.1)	277 (23.4)	64 (5.4)	555 (46.9)	58 (4.9)	216 (18.3)	1,183 (100.0)
Other urban areas							
Wage employees	7 (1.3)	206 (39.1)	38 (7.2)	209 (39.7)	26 (4.9)	41 (7.8)	527 (100.0)
Self-employed	13 (2.6)	217 (43.3)	27 (5.4)	171 (34.2)	20 (4.0)	52 (10.4)	500 (100.0)
All OUA workers	21 (2.0)	423 (41.2)	65 (6.3)	380 (37.0)	46 (4.5)	93 (9.1)	1,027 (100.0)
All urban areas of Peru							
Wage employees	15 (1.2)	345 (26.9)	76 (5.9)	601 (46.8)	62 (4.8)	184 (14.3)	1,283 (100.0)
Self-employed	18 (2.0)	355 (38.3)	53 (5.7)	334 (36.0)	42 (4.6)	125 (13.5)	927 (100.0)
All urban workers	33 (1.5)	700 (31.7)	129 (5.8)	935 (42.3)	104 (4.7)	309 (14.0)	2,210 (100.0)

Note: Number of workers (percentage of group in parentheses).

Since we do not have direct information on the calendar years during which individuals in the sample attended school, we do not know the exact proportion of the sample still in school subsequent to 1972, when the country's education reform was announced. However, if we assume that every individual in the sample began primary school at the age of six and remained in school without interruption until reaching the highest level completed, then we can say that 73 percent of those in the sample who continued beyond the first three years of secondary school finished school before 1972 and, necessarily therefore, received a traditional education as depicted in Figure 1. No more than 27 percent (290 individuals) finished school later than 1972 and could have, for this reason alone, attended a First- or Second-Cycle ESEP. Since the reform was never fully implemented, the actual percentage, though not known, was certainly smaller than this.

5. The Hourly Earnings Function

The model used to compare the returns to general education and to vocational/technical education (VTE) in Peru is derived from the standard human capital earnings function (see Mincer 1974). The means and standard deviations of all of the variables used in the analysis are given in table 5.

Model I. We have standardized the basic human capital earnings function by hours worked and extended it to include, in addition to schooling and experience, other socio-economic and institutional factors (V_m, m=1,...,n) that may be correlated with earnings. Moreover, education is here specified as a set of spline variables (S_j, j=1,...,5) so as to allow the return to an additional year of education to differ by both level and type of education. Finally, each individual's work experience is split into two parts (X_k, k=1,2) so as to distinguish experience in the present job from experience prior to that. The resulting hourly earnings function is as follows:

$$\ln Y_i = \alpha + \Sigma_j \beta_j S_{ji} + \Sigma_k \gamma_k X_{ki} + \Sigma_k \delta_k X_{ki}^2 + \Sigma_m \eta_m V_{mi} + \epsilon_i,$$

where Y_i is the hourly earnings of the i-th worker, α, β_j, γ_k, δ_k, and η_m are the slopes to be estimated, and ϵ_i is a stochastic disturbance term.

The dependent variable is the natural logarithm of self-reported hourly earnings. For those in the wage sector, included in "earnings" in addition to base salary are all bonuses plus the monetary value of benefits provided by the employer such as food, housing, and clothing (see Stelcner, Arriagada, and Moock 1987). For the self-employed, "earnings" are taken to be net of all production costs.

Since the data set includes information only on the last level of education attended, we do not know what kind of secondary school those who continued to the tertiary level actually attended. We have assumed here that all who continued to a university or to a post-secondary VTE institution followed a general secondary curriculum and that no one who went to a secondary technical school continued beyond that level.

Table 5

DESCRIPTIVE STATISTICS [a]

Variable name	Metropolitan Lima		Other urban areas		All urban areas
	Wage employees	Self-employed	Wage employees	Self-employed	Both sectors
Dependent variable (Y)					
HOURLY EARNINGS (June 1985 Intis)	6.71 (7.8)	6.37 (6.5)	4.95 (5.4)	5.75 (7.3)	6.01 (7.0)
LN HOURLY EARNINGS	1.53 (0.8)	1.48 (0.9)	1.18 (0.9)	1.29 (1.0)	1.38 (0.9)
Schooling (S_s)					
YRS PRIMARY	4.85 (0.7)	4.67 (0.9)	4.59 (1.0)	4.47 (1.2)	4.67 (1.0)
YRS SECONDARY TECHNICAL	0.22 (1.0)	0.26 (1.0)	0.29 (1.1)	0.24 (1.0)	0.25 (1.0)
YRS SECONDARY GENERAL	3.25 (2.1)	2.62 (2.3)	2.16 (2.3)	2.00 (2.3)	2.59 (2.3)
YRS POST-SECONDARY NONUNIV.	0.14 (0.7)	0.12 (0.6)	0.12 (0.6)	0.12 (0.6)	0.12 (0.6)
YRS UNIVERSITY	0.74 (1.7)	0.71 (1.8)	0.32 (1.2)	0.39 (1.3)	0.55 (1.5)
Experience (X_e)					
POTENTIAL JOB EXPERIENCE [b]	18.09 (13.4)	25.07 (14.8)	19.86 (13.9)	26.61 (15.2)	21.80 (14.6)
POTENTIAL JOB EXPER. SQUARED x 10^{-2}	5.06 (6.5)	8.48 (8.5)	5.86 (7.1)	9.38 (9.0)	6.89 (7.9)
YEARS IN PRESENT JOB	6.35 (8.1)	8.70 (9.4)	7.71 (8.8)	11.51 (11.2)	8.30 (9.5)
YEARS IN PRESENT JOB SQUARED x 10^{-2}	1.06 (2.3)	1.65 (3.2)	1.36 (2.6)	2.58 (4.3)	1.59 (3.1)
Other variables (V_o)					
PRIVATE SCHOOL [c]	0.176	0.171	0.108	0.086	0.138
TRAINING [d]	0.368	0.340	0.271	0.226	0.307
MARRIED	0.546	0.719	0.641	0.788	0.657
MIGRANT [e]	0.652	0.752	0.736	0.760	0.716
MOTHER'S YRS SCHOOLING [f]	4.09 (3.6)	3.41 (3.5)	2.62 (3.2)	2.42 (3.0)	3.23 (3.4)
FATHER'S YRS SCHOOLING [f]	5.80 (3.8)	5.10 (3.7)	4.28 (3.5)	4.07 (3.1)	4.91 (3.7)
LABOR UNION MEMBER	0.312	---	0.256	---	0.289
JOB CONTRACT	0.224	---	0.228	---	0.225
DIPLOMA SECONDARY TECHNICAL	0.024	0.035	0.027	0.016	0.025
DIPLOMA POST-SECONDARY NONUNIV.	0.022	0.023	0.015	0.020	0.020
UNIVERSITY DEGREE	0.083	0.080	0.032	0.034	0.059

Notes: [a] Means (standard deviations in parentheses).
[b] Age - schooling - years repeated - 6.
[c] Last school attended private.
[d] Attended post-school training course.
[e] Migrated to present location.
[f],[g] If missing, years measured at sample mean and individual assigned value of 1 on separate missing value indicator variable.

Potential experience is imputed in the usual way, with experience set equal to age minus years of schooling attended (years completed plus years repeated) minus six. In this study, however, explicit information on each worker's experience in his present job was obtained during the household interview, and this measure is also included in the estimating equations.[7]

Mother's and father's education are included in the earnings functions as measures of family background. Included also are variables (1 if yes, 0 if no) to capture the effects of each of the following on hourly earnings: (a) having attended a private school at the highest level of education attended; (b) being married; (c) having received post-school training (cf. Arriagada 1988); and (d) having migrated to the present city of residence from somewhere else.

We estimated this earnings function (referred to as Model I in the tables below) for the entire sample of male workers and then separately: (a) by region -- that is, for the residents of Lima (LIMA) and for those in other urban areas (OUAs); (b) by sector -- for those working in the wage sector (WAGE) and for those who are self-employed (SELF); and finally, (c) by the intersection of region and sector -- for each of the four groups (LIMA/WAGE, LIMA/SELF, OUAs/WAGE, OUAs/SELF). We conducted tests of sample homogeneity across the various groups and concluded that country-wide or region-wide estimates would be biased -- see table 6. Accordingly, no regression results are presented here except for the four groups separately.

Table 6

TESTS OF SAMPLE HOMOGENEITY

	F-value	Degrees of freedom	Significance level
Lima vs OUAs	3.26	16 and 2,178	.01
Wage- vs self-employed	1.92	16 and 2,178	.05
Lima/wage vs Lima/self vs OUAs/wage vs OUAs/self	2.08	48 and 2,146	.01

Note: For the test statistic, see Chow (1960) or Johnston (1972, pp. 197-207).

[7] We also tested for interactive effects between experience and schooling. None of the multiplicative terms was statistically significant, and the results are not reported here.

Model II. For the wage employed only, we present a second set of equations controlling for "institutional" factors (factors other than the individual's own human capital) that are likely to affect earnings. Binary variables are added indicating: (a) that the individual belongs to a labor union, which can be expected to increase wages by restricting the supply of workers, and (b) that he holds a contract, which may either raise earnings (if, say, a contract is an indicator of the worker's all-around strong bargaining position vis-a-vis the employer) or lower them (if rates of pay are traded off against job security in the labor market).

Model III. Neither Model I nor Model II, however, makes a distinction between the effect of spending one more year in school and the effect of obtaining an educational credential or certificate at the end of a full course of study consisting usually of several years in school. To separate these two statistical effects, we experimented with a third set of equations in which dummy variables were added indicating certificates received by individuals in the last level of education attended. In Model III, we tried to control for certification effects in order that the regression coefficient on each corresponding education spline variable could be said to measure the pure effect of just one more year of the particular level and type of schooling.[8]

A statistically significant effect associated with the holding of an educational certificate may indicate one (or more) of the following three things: (a) that there is economic rent included in the wages paid the certificate holders; (b) that those who earn the certificate are simply smarter on average than those who do not; or (c) that certificate holders actually learn more per time spent in school than those who drop out.[9] The regression coefficient on the certificate variable may, in other words, be interpreted as a market segmentation effect, an innate ability effect, or an educational effect (or, most probably, a combination of all three).

Only in the case of Lima wage employees do we find any statistically significant effect associated with the holding of education certificates, and there only in the case of university degree holders. For the other three groups, there are either too few individuals in the sample with secondary or post-secondary credentials to obtain trustworthy estimates, or where there are sufficient numbers, the estimated effects are not statistically different from zero. Accordingly, Model III estimates

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[8] Three certificate variables were added. The first indicates possession of a secondary technical diploma, the second a post-secondary nonuniversity diploma, and the third a university degree. (No diploma is given at the end of a secondary general course, which is not to say that there could not still be a "finishing-the-course" effect, additional to the value of one more year of school.)

[9] The last effect might occur in a situation where all parts of a course of study, like pieces in a jig-saw puzzle, are needed before an individual can fully understand and make use of any one part.

are presented here only for the group of Lima wage employees. And for them, because the inclusion of lower-level certificate variables results in nonsignificant regression coefficients and also renders the coefficients for the corresponding years-of-education variables nonsignificant owing to the collinearity between years of education and certification, the Model III equation includes only the university degree certificate variable.

Selectivity Bias. We do not have a sufficient number of theoretically relevant background variables to test for self-selectivity in an individual's choice between VTE and general education, given that this decision could have been made far in the past and the PLSS data set is cross-sectional rather than longitudinal. We do, however, test for selectivity in the present-day choice between wage employment and self-employment. Economic theory says that an individual will choose whichever sector of employment promises the highest net marginal returns. OLS (ordinary least squares) estimates of the earnings equations specified above will be biased to the extent that there are variables omitted from an earnings equation that determine the probability of being in either the wage or self-employed sector. Their omission implies that the error terms of the earnings and labor supply equations will be correlated.

To take into account the choice between wage employment and self-employment, i.e., to adjust for selectivity bias, we use the standard econometric procedure introduced by Heckman (1976; 1979). We first estimated a set of probit equations to determine, separately, for all males in Lima, and then for all males in OUAs: (a) the probability of being employed in the private wage sector versus all other options (including, but not restricted to, self-employment), and (b) the probability of being self-employed versus all else (including, but not restricted to, wage employment). The following right-hand variables were used in estimating the probit functions: age, age squared, the five splines representing each level and type of schooling, the three educational certificate variables, the training and marriage variables, years in the current place of residence, annual unearned income, father's occupation, the number of children in the household, and hectares of land owned by the household. From each probit an estimate of the inverse Mills-ratio, or "lambda" (λ), was derived.

In the second step of the adjustment procedure, we re-estimated the wage equations with lambda included on the right-hand side to control for the probability of being in the particular sector. With the exception of the self-employed in Lima, we found no evidence of selectivity bias in the original OLS equations, in which one assumes that wage workers and the self-employed are random subsets of the active population of workers. The addition of lambda did not affect the regression coefficients, and the coefficients on lambda itself were not significantly different from zero.

For the self-employed in Lima, however, the coefficient on lambda was positive and significant, and its inclusion lowered the estimated effects of some variables including those of both general and technical secondary schooling. This points to the existence of unobserved factors in Lima that may increase both the probability of becoming self-employed and

also the likelihood of above-average hourly earnings. Quite possibly, those with greater innate entrepreneurial ability are more likely than others to select self-employment. By failing to correct for the self-selection of this group, the returns to education are biased upwards to include the effect of this unmeasured entrepreneurial ability. For this group, the selectivity-corrected estimates will be displayed alongside the OLS estimates.

6. Estimation of the Hourly Earnings Function

This section presents the regression results. The findings are described and discussed, first for the group of private-sector wage employees, and then for the self-employed.

Wage Employees. The estimates for the wage-employed are given in table 3. The hourly earnings of this group are quite well explained by the human capital earnings function. The R^2s of the final regression are 0.446 for Metropolitan Lima and 0.369 for Peru's OUAs.

In the case of Lima, all three models could be estimated reliably. For other urban areas, estimates of the first two models only are reported because relatively few individuals in the OUA sample possessed the educational certificates needed to distinguish Model III from Model II. For Lima, the inclusion of the university degree variable does not add to the explanatory power of the regression equation, but it reduces the estimated effect of one more year of university education by about four percentage points, which amounts to roughly a third.

The two institutional factors (union membership and job contract) are strongly related to earnings in both regions, with t-values ranging from 1.7 to 6.0. Together the two factors uniquely explain about one percent of the observed variation in earnings in Lima, and eight percent in OUAs. Their addition to the regression equations, in Model II, neither lowers nor raises the schooling coefficients to any great extent (never by as much as two percentage points) nor in any systematic fashion (sometimes in one direction, sometimes the other).

For both Lima and OUAs, the effect of an additional year of education -- be it general or technical, primary, secondary, or tertiary -- diminishes as we move from lower- to higher-order models and thereby control for additional nonhuman capital variables.[10] In Lima the highest marginal returns (8-9 percent in Model III, which controls for the possession of a university degree, and 13-14 percent in Model II, which does not) and in OUAs the lowest marginal returns (4-6 percent) accrue to tertiary education. This supports the casual observation that high-level

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[10] The results obtained for a simpler model, not shown here, analogous to the original human capital earnings function introduced by Mincer (1974) and including just the schooling splines and experience variables, had the largest coefficients and largest t-values.

Table 7

REGRESSION RESULTS -- WAGE EMPLOYEES

		Lima			Other Urban Areas	
		Model I	Model II	Model III	Model I	Model II
INTERCEPT		-0.027 (-0.14)	-0.042 (-0.22)	-0.024 (-0.12)	-0.740 (-3.84)++	-0.528 (-2.50)++
YRS PRIMARY	(β_1)	0.052 (1.37)	0.052 (1.36)	0.053 (1.40)	0.098 (2.27)++	0.080 (1.95)+
YRS SECONDARY TECHNICAL	(β_2)	0.056 (2.18)++	0.057 (2.23)++	0.057 (2.25)++	0.085 (2.52)++	0.069 (2.15)++
YRS SECONDARY GENERAL	(β_3)	0.061 (4.03)++	0.058 (3.84)++	0.058 (3.86)++	0.086 (4.07)++	0.076 (3.81)++
YRS POST-SECONDARY NONUNIV.	(β_4)	0.134 (3.72)++	0.117 (3.24)++	0.114 (3.19)++	0.035 (0.60)	0.041 (0.74)
YRS UNIVERSITY	(β_5)	0.147 (9.24)++	0.134 (8.32)++	0.090 (3.91)++	0.056 (1.74)+	0.048 (1.58)
POTENTIAL JOB EXPERIENCE		0.037 (4.73)++	0.036 (4.57)++	0.035 (4.44)++	0.064 (5.60)++	0.054 (4.96)++
POTENTIAL JOB EXPERIENCE SQUARED x 10^{-2}		-0.044 (-2.95)++	-0.042 (-2.82)++	-0.040 (-2.70)++	-0.095 (-4.67)++	-0.078 (-4.04)++
YEARS IN PRESENT JOB		0.023 (2.65)++	0.021 (2.39)++	0.020 (2.30)++	0.039 (3.14)++	0.031 (2.54)++
YEARS IN PRESENT JOB SQUARED x 10^{-2}		-0.049 (-1.68)+	-0.050 (-1.72)+	-0.047 (-1.63)+	-0.077 (-1.95)+	-0.063 (-1.66)+
PRIVATE SCHOOL		0.100 (1.49)	0.111 (1.68)+	0.129 (1.95)++	0.143 (1.22)	0.114 (1.03)
TRAINING		0.181 (3.59)++	0.170 (3.38)++	0.177 (3.55)++	-0.031 (-0.38)	-0.069 (-0.89)
MARRIED		0.270 (4.32)++	0.262 (4.23)++	0.246 (3.97)++	0.038 (0.41)	-0.057 (-0.64)
MIGRANT		-0.061 (1.17)	-0.049 (-0.94)	-0.050 (-0.96)	0.069 (1.23)	0.049 (0.65)
MOTHER'S YRS SCHOOLING		0.017 (1.92)+	0.017 (2.00)++	0.016 (1.89)+	0.037 (2.56)++	0.037 (2.69)++
FATHER'S YRS SCHOOLING		0.029 (3.09)++	0.028 (3.65)++	0.028 (3.67)++	0.030 (2.27)++	0.022 (1.81)+
LABOR UNION MEMBER			0.148 (2.74)++	0.148 (2.76)++		0.505 (6.02)++
JOB CONTRACT			0.114 (1.97)++	0.100 (1.71)+		0.263 (3.12)++
UNIVERSITY DEGREE				0.357 (2.71)++		
ADJUSTED R^2		0.433	0.442	0.447	0.288	0.369
F VALUE [DEGREES OF FREEDOM]		34.86 [17,738]++	32.50 [19,736]++	31.51 [22,733]++	13.54 [17,509]++	17.17 [19,507]+
Relative Effects						
VTE vs GENERAL						
Secondary	(β_2 - β_3)	-0.005 (-0.23)	-0.001 (-0.06)	-0.001 (-0.06)	-0.001 (-0.04)	-0.007 (-0.25)
Tertiary	(β_4 - β_5)	-0.013 (-0.34)	-0.017 (-0.48)	-0.025 (-0.64)	-0.021 (-0.33)	-0.007 (-0.10)
SECONDARY vs PRIMARY						
Technical	(β_2 - β_1)	0.004 (0.07)	0.005 (0.10)	0.004 (0.08)	-0.013 (-0.22)	-0.011 (-0.19)
General	(β_3 - β_1)	0.009 (0.20)	0.006 (0.14)	0.005 (0.12)	-0.012 (-0.22)	-0.004 (-0.06)
TERTIARY vs SECONDARY						
PSNU	(β_4 - β_3)	0.073 (1.82)+	0.059 (1.49)	0.056 (1.39)	-0.051 (-0.77)	-0.035 (-0.55)
University	(β_5 - β_3)	0.086 (3.54)++	0.076 (3.12)++	0.031 (1.07)	-0.030 (-0.71)	-0.028 (-0.72)

Note: *t*-statistics in parentheses; two pluses (one plus) = coefficient statistically significant at 5% (10%) level in a two-tailed test.

private-sector jobs in Peru are concentrated in Lima. Even the high rates of migration into Lima have not, to date, brought pay rates between the two regions into equilibrium. The marginal returns to lower levels of education, though not always reliably estimated (for the Lima sample, β_1 has a standard error nearly three-fourths its own size), are in the five-to-ten percent annual range both in Lima and in OUAs.

In both regions, general education appears to yield higher marginal returns than VTE. The difference is never large, however, less than one percentage point in the case of secondary education and less than three in the case of tertiary education. To see whether any of these differences are statistically significant, t-tests were conducted. In no case can the null hypothesis be rejected, even at the 10 percent level (see t-tests for "relative effects" in bottom half of table). Neither are there significant differences in the marginal returns to different levels of education. For statistical purposes, the hourly earnings functions in table 7 could have been specified as having just one years-of-education variable.

The regression results with respect to the schooling variables (for the highest of the three models estimated, i.e., Model III in the case of Lima and Model II in the case of OUAs) are summarized graphically in figure 2. The slope of any graph indicates the marginal effect of an additional year of education of a particular level and type.[11]

A two-headed arrow between a graph and the horizontal line indicates that the slope of the graph is significantly different from zero (cf the t-values for the β_i coefficients near the top of table 5). An arrow between two graphs indicates (or would indicate -- there is no such arrow in figure 2) that the difference between the regression coefficients for two different types or adjacent levels of education is significantly different from zero (cf the t-values for the $\beta_i - \beta_{i*}$ differences at the bottom of table 5). Fat and thin arrows indicate statistical significance at the 5 and 10 percent levels, respectively.

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[11] The slope, which shows the percentage change in earnings associated with an additional year of school, is calculated from the regression coefficient, β, as follows:

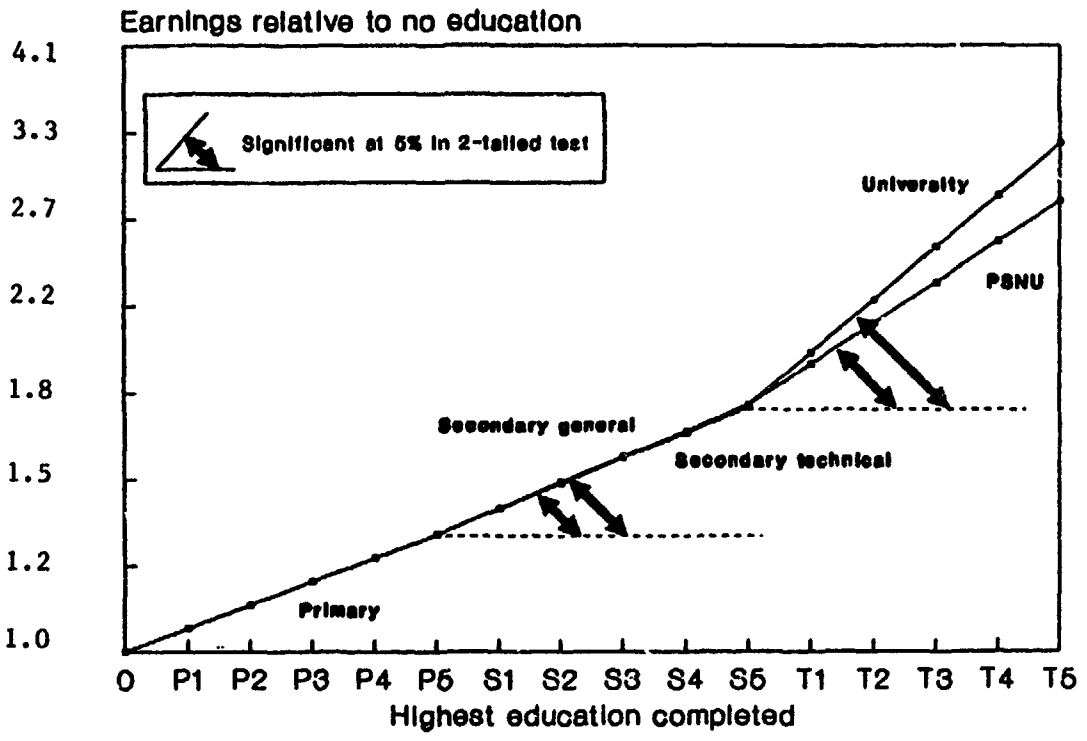
$$[(\exp)^{\beta} - 1] \times 100\%$$

The marginal effects are shown here in linear form, with adjustment of the vertical scale to reflect the fact that percentage increments in earnings increase more than linearly.

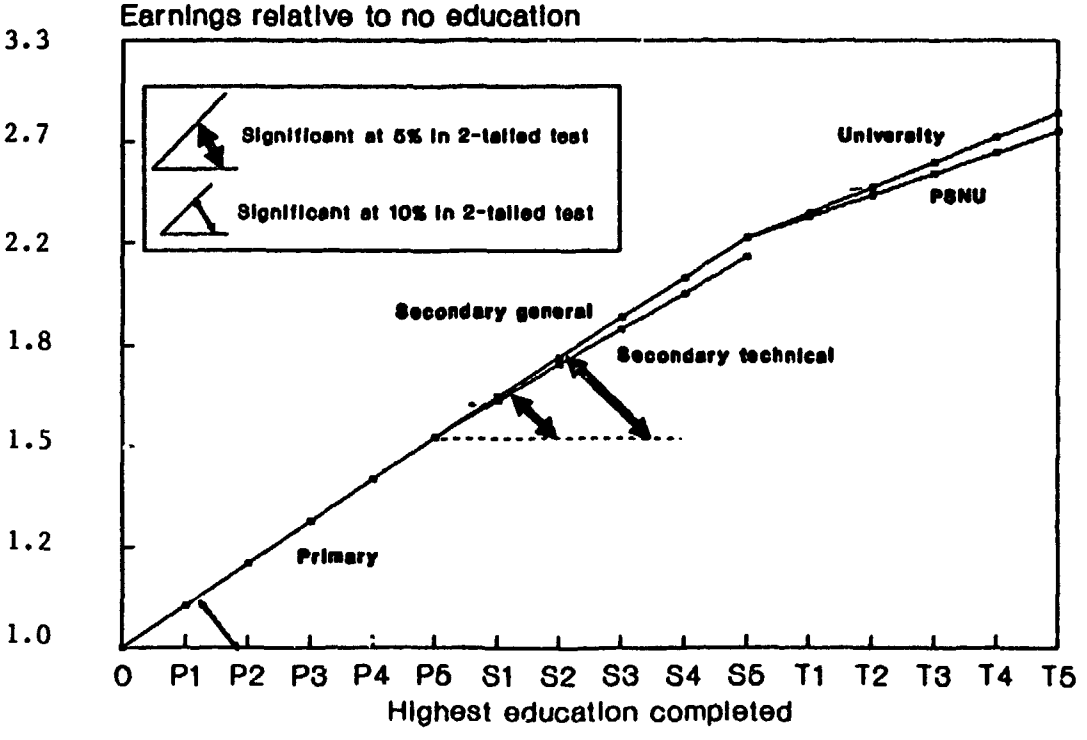
Figure 2

MARGINAL EFFECTS OF EDUCATION -- WAGE EMPLOYEES

Lima



Other Urban Areas



Self-Employed Workers. The estimates for the self-employed are given in table 8. Because the self-reported "earnings" of self-employed workers reflect not just the return on past human capital investment (included in the regression equations) but also the return on physical capital belonging to the enterprise (not included in the equations), the regressions here explain only 14-17 percent of the variation in reported hourly earnings, and the results should be approached with some caution.[12]

The pattern of returns across different levels and types of education is more complicated for the self-employed than it is for the wage-employed. For Lima (after introducing the correction for selectivity bias), the point estimate of the return to an additional year of primary education is negative, and in OUAs, the same is true for secondary technical education, but neither regression coefficient approaches statistical significance (the t-values are only -0.14 and -0.78, respectively). Statistically significant marginal returns are found in the following cases: for Lima, secondary technical and university education, and for OUAs, primary, secondary general, and university education. The results are presented graphically in figure 3.

One anomalous pair of findings relates to secondary technical education. In Lima, the returns to this level and type of education are high. The point estimate exceeds nine percent annually. Although, when one looks at the graphs for Lima, the marginal return to secondary technical appears higher than the marginal return to secondary general education, the difference between the two is not statistically significant. In OUAs, on the other hand, the returns to secondary technical education are low. The point estimate is actually negative. The value, while not significantly different from zero, is significantly smaller than the marginal return to secondary general education.

Why should the marginal return to a year of secondary technical education be so much higher in Lima than in OUAs? One explanation could be that there was a difference in the quality of the VTE received by those now working in the two regions. The data included some indirect indicators of school quality, but only in relation to the primary school attended by each individual in the sample. These are not useful, therefore, in measuring the quality of secondary education.

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[12] Because earnings are self-reported and because respondents may confound the distinction between "gross" and "net" earnings, the dependent variable for the self-employed can be expected to include substantial measurement error. Different hourly earnings regressions for all self-employed men and women operating single-person enterprises (a majority of the self-employed group in the PLSS sample) are reported in Stelcner et al. (forthcoming). There the capital assets of the enterprise are taken into account, and "earnings" are measured as the difference between "sales" (including the value of output consumed in the household) and purchased recurrent inputs.

Table 8

REGRESSION RESULTS -- SELF-EMPLOYED

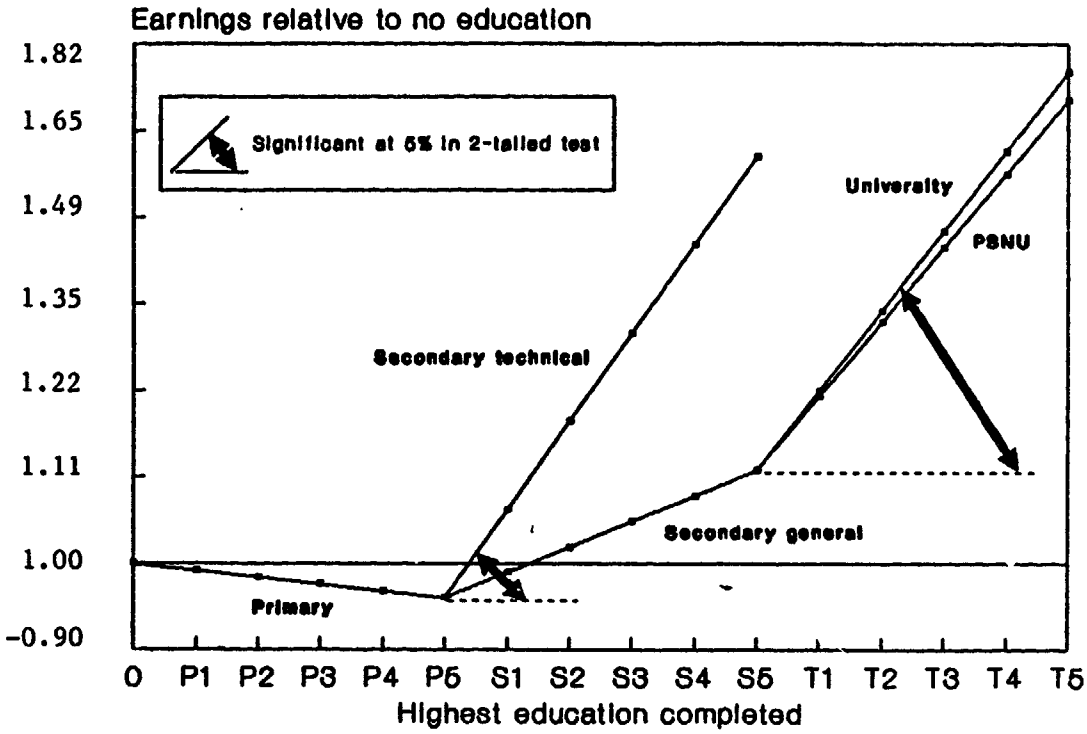
		Lima		Other Urban Areas
		Model I	Selectivity Corrected	Model I
INTERCEPT		0.431 (1.48)	-0.716 (-0.94)	-0.192 (-0.77)
YRS PRIMARY	(β_1)	0.019 (0.36)	-0.008 (-0.14)	0.070 (1.65)+
YRS SECONDARY TECHNICAL	(β_2)	0.118 (2.84)++	0.097 (2.28)++	-0.033 (-0.78)
YRS SECONDARY GENERAL	(β_3)	0.066 (2.68)++	0.029 (0.87)	0.045 (1.74)+
YRS POST-SECONDARY NONUNIV	(β_4)	0.084 (1.14)	0.088 (1.27)	0.072 (1.08)
YRS UNIVERSITY	(β_5)	0.083 (3.08)++	0.082 (3.19)++	0.083 (2.38)++
POTENTIAL JOB EXPERIENCE		0.011 (0.81)	0.022 (1.46)	0.046 (3.68)++
POTENTIAL JOB EXPERIENCE SQUARED x 10^{-2}		-0.016 (-0.72)	-0.023 (-1.01)	-0.082 (-4.17)++
YEARS IN PRESENT JOB		0.027 (1.96)++	0.031 (2.28)++	0.030 (2.65)++
YEARS IN PRESENT JOB SQUARED x 10^{-2}		-0.044 (-1.11)	-0.053 (-1.33)	-0.052 (-1.82)+
PRIVATE SCHOOL		-0.014 (-0.13)	0.007 (-0.07)	0.143 (0.93)
TRAINING		0.020 (0.22)	-0.006 (-0.06)	-0.111 (-1.11)
MARRIED		0.265 (2.50)++	0.363 (3.08)++	0.309 (2.80)++
MIGRANT		0.033 (0.34)	0.002 (0.02)	0.082 (0.83)
MOTHER'S YRS SCHOOLING		0.035 (2.23)++	0.032 (2.08)++	0.018 (1.06)
FATHER'S YRS SCHOOLING		0.010 (0.62)	0.008 (0.60)	0.013 (0.82)
LAMBDA			0.987 (1.64)+	
ADJUSTED R^2		0.166	0.170	0.142
F VALUE [DEGREES OF FREEDOM]		5.98 [17,409]++	5.86 [18,408]++	5.88 [17,482]++
Relative Effects				
VTE vs GENERAL				
Secondary	($\beta_2 - \beta_3$)	0.052 (1.34)	0.068 (1.48)	-0.078 (-1.91)+
Tertiary	($\beta_4 - \beta_5$)	0.001 (0.01)	0.006 (0.09)	-0.011 (-0.16)
SECONDARY vs PRIMARY				
Technical	($\beta_2 - \beta_1$)	0.099 (1.38)	0.105 (1.42)	-0.103 (-1.63)
General	($\beta_3 - \beta_1$)	0.047 (0.74)	0.037 (0.54)	-0.025 (-0.47)
TERTIARY vs SECONDARY				
PSNU	($\beta_4 - \beta_3$)	0.018 (0.23)	0.059 (0.74)	0.027 (0.36)
University	($\beta_5 - \beta_3$)	0.017 (0.42)	0.053 (1.15)	0.038 (0.78)

Note: t-statistics in parentheses; two pluses (one plus) = coefficient statistically significant at 5% (10%) level in a two-tailed test.

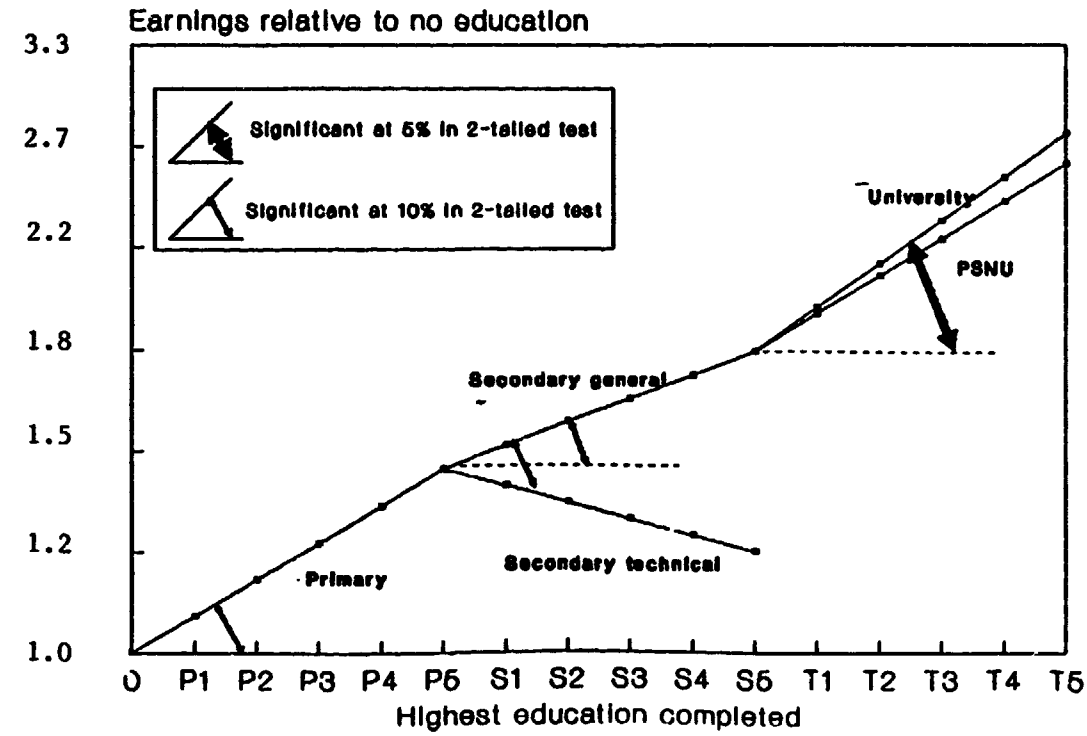
Figure 3

MARGINAL EFFECTS OF EDUCATION -- SELF-EMPLOYED WORKERS

Lima



Other Urban Areas



Instead, we have estimated the location of the secondary school attended, on the assumption that schools that were located in cities might have been of higher quality on average than those located in towns or villages. Since respondents were not asked about the location of schools attended, we use as a proxy the place of residence of the individual when he was of school attendance age -- whether he then lived in a city or not. Table 9 shows where workers lived when they were attending secondary school.

Table 9

OF WORKERS WHO ATTENDED SECONDARY SCHOOL,
PERCENTAGE WHO THEN LIVED IN A CITY

Individuals now living in:	Type of secondary school attended		
	Technical	General	Both
Self-employed workers			
Metropolitan Lima	69.2% (18/26)	68.2% (176/258)	68.3% (194/284)
Other urban areas	29.6% (8/27)	44.9% (109/243)	43.3% (117/270)
All urban areas of Peru	49.1% (26/53)	56.9% (285/501)	56.1% (311/554)
Wage employees			
Metropolitan Lima	63.2% (24/38)	70.9% (405/571)	70.4% (429/609)
Other urban areas	42.1% (16/38)	46.7% (129/276)	46.2% (145/314)
All urban areas of Peru	52.6% (40/76)	63.0% (534/847)	62.2% (574/923)

Fifty-six percent of all self-employed workers who attended secondary school lived in a city as youngsters and, we shall assume therefore, attended "higher quality" schools than those who lived in towns or villages. Of the four groups of self-employed workers, the one with the highest percentage (69.2%) of individuals who then lived in a city is the group who attended secondary technical schools and now live in Metropolitan

Lima. The group with the smallest percentage (29.6%) -- much smaller than for any other group, including all of the wage employee groups -- is the group of technical school attendees now living in OUAs. Although the evidence is not conclusive, the pattern of where individuals lived as youngsters does support the hypothesis that the quality of education received by the self-employed now living in Lima was higher than that received by the self-employed now living in other urban areas. This may, in part, explain the anomaly pointed out in figure 3.

Relative Returns to VTE and General Education. The most pertinent conclusion here with regard to the returns to education in Peru is essentially a null conclusion: With the one exception of education at the secondary level for self-employed workers in other urban areas, there are no significant differences in the marginal returns to education in the two scholastic streams. In all other cases, a year of VTE is the statistical equivalent of a year of general education, at least in terms of their impact on earnings. Why, in light of the officially stated intent that VTE should provide students with specific skills oriented to the manifest requirements of the labor market, should this be so?

One likely explanation is the lack of curricular differences between the two streams. As discussed in Section 2, it is reasonable to suspect that, because of shortages of appropriately trained teachers and suitable equipment, and also because of the difficulty of actually specifying the technical requirements of the labor market, VTE institutions in Peru do not offer education that is substantially different from that which is offered in institutions designated as general institutions. Moreover, and as a consequence of the similarity in the curricula, students from the two streams may end up, once employed, filling jobs that are also substantially the same.

Education and Manual Work. In the data set, workers' jobs can be classified into seven major categories: professional, managerial, services, sales, clerical, farming, and manual. These categories do not relate neatly to the career objectives of the two educational streams, but it does seem reasonable to predict that graduates of VTE would be somewhat more likely than graduates of general education to be employed as <u>manual</u> workers. To test this hypothesis, we postulated a logistic probability model to predict the likelihood of being thus employed. The observed dependent variable assumes the values 1 if an individual worked in a manual job and 0 if he worked in any of the other job categories. On the right-hand side of the equation, in addition to the variable indicating type of education received (1 if VTE, 0 if general) we included three other variables that could be expected to affect the likelihood of being employed in a manual job: POTENTIAL JOB EXPERIENCE, YEARS IN PRESENT JOB, and MIGRANT (see table 5 above).

The logit regression was estimated separately, using a maximum likelihood procedure, for each of eight worker groups: within each of the four regional/sectoral groups, separately for those whose highest level of education was secondary and again for those whose highest level was tertiary. The results are summarized in table 10. Only for the tertiary

education group now living in Lima is there a statistically significant effect of VTE on the likelihood of being employed as a manual worker. For this group, graduates of VTE are 7- to 9-times more likely to be in manual jobs, and the null hypothesis (that there is no relation between VTE and manual work) cannot be rejected at the 5 percent level. For all of the other six worker groups, although graduates of VTE are more likely than graduates of general education to be working in manual jobs (up to 2-times more likely), in no case is this effect statistically significant at the the 10 percent level. One may conclude from this analysis that the relation in Peru between the type of education taken in school and the type of work that an individual performs later when employed is, in general, quite weak.

Table 10

MANUAL WORKERS BY LOCATION, SECTOR, AND HIGHEST LEVEL OF EDUCATION ATTENDED

	Highest level of education attended							
	Secondary				Tertiary			
	Number of manual workers	Percent of group	Effect of VTE in logit regression (β)[a]	Odds ratio (θ)[b]	Number of manual workers	Percent of group	Effect of VTE in logit regression (β)[c]	Odds ratio (θ)[d]
Metropolitan Lima								
Wage employees	221	51	0.504 (1.43)	1.7	19	11	2.223 (4.11)++	9.2
Self-employed	96	51	0.505 (1.15)	1.7	29	31	1.982 (3.52)++	7.3
Other urban areas								
Wage employees	135	55	0.514 (1.38)	1.7	16	24	0.693 (0.94)	2.0
Self-employed	94	47	0.642 (1.47)	1.9	17	24	0.075 (0.11)	1.1

Notes: t-statistics in parentheses; two pluses (one plus) = logit coefficient statistically significant at 5% (10%) in a two-tailed test.

[a,c] Dependent variable in the logit regression: 1 if manual worker, 0 otherwise. VTE variable: 1 if highest education VTE, 0 otherwise; β = logit coefficient on this variable. Other independent variables: POTENTIAL JOB EXPERIENCE, YEARS IN PRESENT JOB, and MIGRANT.

[b,d] $\theta = EXP(\beta)$, to be interpreted as follows: "An individual who took VTE is θ-times more likely to be employed as a manual worker than an individual who did not (given the other four characteristics controlled for in the equation)."

7. Unit Costs

Our results on the determinants of earnings in Peru have corroborated a finding reported for some other countries, that the returns to investment in VTE are comparable to the returns to investment in general education. In most of the studies done elsewhere, however, the costs of VTE have been shown to exceed the costs of general education. In Peru, no such cost differential is clearly evident. Table 11 presents the average central government recurrent expenditure per student per year in secondary and post-secondary education in all years between 1960 and 1981 for which data were available.[13]

For post-secondary education, although some year-to-year variation exists, the Ministry of Education (MoE) data show quite consistently that less was spent per year of study in nondegree granting institutions than in universities. The average ratio of VTE costs to general education costs was 0.8 at the tertiary level between 1970 and 1981. Since most of the individuals in our 1985/86 sample would have attended post-secondary education before 1982, the period covered by the data series is quite relevant for the purpose at hand.

The situation with regard to unit costs at the secondary level is much less clear. According to the MoE figures, VTE costs were between two and three times more than general education costs in the period prior to 1970. For 1978 and 1979, the last two years in the available series, VTE again outstripped general education in terms of unit costs. For the intervening years, however, the costs of the two educational streams appear to have been nearly equivalent. VTE's costs exceeded general education's on average by about 10 percent only.

There is little in the history of Peruvian education and the reforms announced in 1972 and 1982 that helps to explain the wild swings in the relative costs of secondary VTE and general education. Nearly all of the shifts in the relative positions of the two are accounted for by shifts in the former rather than the latter. Although there was an overall downward trend over the period, the fluctuations in expenditure per general education student between 1960 and 1979 were comparatively small, the reported figure in the highest year (1965) being just about double that in the lowest (1979). In the case of VTE on the other hand, reported expenditure per student in real terms was nearly four times larger in 1965 than in 1977. Some possible explanations for these puzzling figures will be considered in the following section.

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[13] Owing to the absence of data on unsubsidized educational costs incurred by individuals, on expenditure by lower levels of government, and on capital costs whatever the source of financing, the discussion of costs in this study will refer only to recurrent, central government expenditures.

Table 11

RECURRENT EXPENDITURE PER STUDENT, 1960-1981

	Expenditure per student (constant 1985 Intis)					VIE/general expenditure ratio			
						Secondary		Post-secondary	
Year	Primary (a)	Secondary technical (b)	Secondary general (c)	Post-sec. non-univ. (d)	University (e)	Annual (b)/(c) (f)	Average 1970-77 (g)	Annual (d)/(e) (h)	Average 1970-81 (i)
1960	587	3,941	1,412	.	.	2.8		.	
1965	989	5,075	1,941	.	.	2.6		.	
1970	923	1,866	1,634	4,933	8,754	1.1		0.6	
1971	922	1,513	1,621	6,150	9,336	0.9		0.7	
1972	1,184	1,645	1,919	4,294	7,673	0.9		0.6	
1973	1,021	1,903	1,765	7,333	8,008	1.1		0.9	
1974	994	1,705	1,643	6,820	6,318	1.0	1.1	1.1	
1975	983	1,463	1,424	6,008	8,472	1.0		0.7	
1976	956	1,426	1,287	6,973	6,008	1.1		1.2	0.8
1977	861	1,303	1,008	5,029	5,916	1.3		0.9	
1978	638	2,681	1,098	4,604	4,676	2.4		1.0	
1979	550	2,163	932	4,206	4,851	2.3		0.9	
1980	915	.	.	3,828	5,574	.		0.7	
1981	835	.	.	3,443	5,421	.		0.6	

Sources: Per student expenditures were supplied by the Ministry of Education and reported in Arregui (1988). GDP deflators were provided by the Instituto Nacional de Estadistica and reported in Webb (1987).

8. Investment in Vocational and Technical Education

To see the implications of the above findings for educational policy in Peru requires that the data on marginal costs and marginal returns be placed in juxtaposition. That the returns to a year of VTE and a year of general education are found to be essentially the same implies one thing if VTE is more expensive to provide than general education and quite another if the unit costs of the two are much the same. Table 12 summarizes the findings from earlier sections on the costs and returns to VTE and general education in Peru.

The comparison between costs and returns is clear-cut in the case of post-secondary education. Here, in the four locational/sectoral samples the return to a year of post-secondary nonuniversity education varies between 90% and 110% of the return to a year of university education. Averaging across the four samples, one may conclude that the return to VTE in the country as a whole is just slightly below the return to university education. This is quite consistent with the information on costs, taken from table 11 in the previous section. On a year by year basis, unit costs in post-secondary nonuniversity education have varied as a percentage of unit costs in university education from a low of 60% to a high of 120% and averaged about 80%. In comparing costs and benefits, one can say that the "competition" between VTE and general education at the post-secondary level amounts to a virtual draw.

The situation with regard to secondary education is more complicated. In terms of averages, once again the picture suggests a high degree of equilibrium between the additional costs and additional returns of VTE relative to general education. Both costs and returns are approximately 10% higher on average. For secondary education, however, the data points are very dispersed. For the self-employed in Lima, though the difference is not statistically significant, each year of VTE is associated with a proportionate increase in earnings three and a half times greater than a corresponding year of general education. On the other hand, for the self-employed in OUAs, VTE is negatively related to earnings (though not significantly so) whereas general education yields a moderately high return. In between, for both groups of wage workers, the marginal return to VTE is just slightly below the return to general education.

The pattern of unit costs in secondary education, as the reader will recall, is even less stable. Although the figures show considerable uniformity for the years between 1970 and 1977 (the period for which the 1.1:1 ratio -- expenditure on secondary technical education to expenditure on secondary general -- has been derived), the data for the years before 1970 and years since 1977 show VTE to be much more expensive than this, at least twice as much relative to general education. Disregarding the earliest period -- which, even if the figures are accurate, is now "ancient history" -- one must consider the implications of the very latest figures.

Table 12

COMPARISON OF RELATIVE BENEFITS AND RELATIVE COSTS OF VTE AND GENERAL EDUCATION

	Secondary education					Post-secondary education				
	Return to year of:		Ratio of marginal returns		Expenditure ratio	Return to year of:		Ratio of marginal returns		Expenditure ratio
	Technical	General	By group (a)/(b)	Average all four groups	Average 1976-77[a]	Non-university	University	By group (g)/(h)	Average all four groups	Average 1976-81[b]
	(a)	(b)	(c)	(d)	(f)	(g)	(h)	(i)	(j)	(k)
Wage employees										
Lima	4.4%	5.9%	0.7			8.4%	9.3%	0.9		
OUAs	7.1%	7.9%	0.9	1.1	1.1[c]	4.2%	4.9%	0.9	0.9	0.8
Self-employed										
Lima	10.2%	2.9%	3.5			9.2%	8.5%	1.1		
OUAs	-3.2%	4.6%	-0.7			7.5%	8.7%	0.9		

[a,b] From table 10.

[c] Twice as high in 1978 and 1979 (the last two years for which data available).

There are at least two possible explanations for the rapid escalation in the unit costs of secondary technical education in the late 1970s. One would be a decline in the number of students enrolled in such schools. UNESCO figures do, indeed, show a dramatic decline in VTE enrollments between 1977 and 1978 (UNESCO 1986), but whether this was, in fact, real or represents some sort of statistical artifact (perhaps the result of a student reclassification) is not known. In either case, a decline in the denominator (number of students) without a commensurate decline in the numerator (total expenditure) will result in an increase in expenditure per student. Unless there is reason to believe that the decline in the number of students is only a temporary phenomenon, then there can be no justification for constructing additional schools of this type. Until the costs of technical education can be brought down again (presumably by closing some of the existing VTE schools and consolidating the rest), VTE will remain a poor investment option relative to general education.

An increase in unit costs could have occurred also within the context of educational reform. As discussed in Section 2, under the reform program introduced in 1972, a number of new technical schools (ESEPs) were constructed. Given that many of these schools did not open their doors until the late 1970s, it is likely that they were not yet fully enrolled and that the high unit costs noted above do not represent the full-capacity costs of providing this kind of education.

Moreover, to address some of the shortcomings posited above with respect to staffing, equipment, and curriculum of VTE institutions would have required (to the extent that they were, in fact, addressed) inevitably the mobilization of additional resources. The resulting increase in expenditure per student might be justified if it led to graduates of the VTE system who were truly better prepared for the world of work and who could sustain a higher level of productivity over the period of their working lives.

We do not know to what extent the higher expenditures per VTE student after 1977 represents an anomaly in the statistical series or whether more recent information will corroborate the apparent trend. If it is determined that the unit costs of secondary VTE are, indeed, on the rise in Peru, then additional research will be needed that can track the occupational attainment and productivity of new output from the VTE system. All that can be said at this stage is that any significantly higher costs of producing new VTE graduates could not be justified in light of the earnings performance of existing graduates in the Peruvian work force.

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